

ACTIVITY 7

THE RIGHT ORDER

Objective

Students become familiar with the space transportation system (STS), its parts, and the sequence of a space shuttle launch.

Standards

Science, Mathematics, Technology, Language Arts

Materials

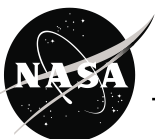
- Drawings of space shuttle (Figure 2, page 74 and Figure 3, page 75), colored
- 1 set of shuttle sequence cards (Figure 10, page 81), enlarged, colored and cut out
- Drawing of space shuttle parts (Figure 11, page 82), colored and cut out
- Diagram of shuttle launch to orbit sequence (Figure 12, page 83), colored
- Shuttle sequence cards (Figure 10, page 81), 1 set per student
- Model of the space shuttle, available from toy stores
- Pictures of a shuttle launch
- Videotape of a shuttle launch
- VCR and TV
- Small closeable plastic bags, 1 per student

Educator Information

- This activity may require two class periods.
- Review the background information on the International Space Station (ISS) and the space shuttle. Be prepared to share it with students.
- Read the following additional information on the space shuttle. Be prepared to share it with the class.
- Be prepared to show students drawings, pictures, or models of the space shuttle. Be able to point out the different parts to the class.

NASA uses the space transportation system (STS), or space shuttle, to take people, supplies and hardware to the ISS. It has a unique design. The space shuttle is a special type of rocket. It consists of several different parts. The orbiter is the white triangular shaped piece, the only part of the shuttle that travels into space. The orbiter houses the crew and carries the components of the ISS in the payload bay. The orbiter needs two white solid rocket boosters and a large orange external tank to reach space. Like many rockets, the space shuttle has several different steps in its launch sequence.

Refer to Figure 12, page 83, featuring the shuttle launch to orbit sequence. The



countdown begins, and the rocket engines ignite. The space shuttle lifts off the launch pad at Kennedy Space Center in Florida. Kennedy Space Center is located near the Atlantic Ocean, on the coast of Florida, close to Cape Canaveral. The space shuttle travels into the sky, leaving a trail of smoke. The solid rocket boosters contain solid propellant. This solid fuel is the consistency of a pencil eraser. The solid rocket boosters burn for about two minutes and help the orbiter to travel high into the sky. The propellant is then completely used. There is no longer any need for the solid rocket boosters. At approximately the two-minute mark, the boosters jettison, or separate, from the external tank and orbiter. They descend into the Atlantic Ocean beneath large parachutes. Ships are waiting to recover the solid rocket boosters and pull them back to shore. People carefully check the boosters and prepare them for launch again on another shuttle flight.

The large orange external tank remains attached to the orbiter. Inside the external tank are liquid hydrogen and oxygen. Hydrogen and oxygen are normally found in gaseous form. In the external tank, hydrogen and oxygen are so cold that they exist in a liquid state. Liquid hydrogen and oxygen are good rocket propellants. The external tank supplies fuel to the three main rocket engines at the aft end of the orbiter. At approximately eight minutes after liftoff, the external tank has no more propellant. The external tank has completed its task to get the orbiter into space. There is no longer any need for the external tank. It separates from the orbiter and tumbles to Earth. As it falls through the Earth's atmosphere, it becomes very hot. The external tank burns up before it reaches the Earth's surface.

Approximately 40 minutes later, the orbital maneuvering system (OMS) engines fire to complete the vehicle's trip to orbit. The orbiter circles, or orbits, the Earth. It often brings hardware, people, and supplies to the ISS.

After the orbiter finishes its mission in space, it returns to Earth. The orbiter lands on a runway. A parachute is used to help the orbiter stop. At Kennedy Space Center, the orbiter is serviced and prepared to return to space. It is a reusable launch vehicle.

- Enlarge, color, and cut out one set of shuttle sequence cards. Write numerals on the back to indicate the correct order of a shuttle launch. Laminate for future use.
- Copy and color the diagram of a shuttle launch to orbit sequence. Laminate for future use.
- Copy and color drawings of the space shuttle and shuttle parts. Laminate for future use.

Procedure

First Class Period:

1. Use videotapes, models, drawings or photographs to show students a shuttle launch to orbit sequence. Share information on the sequence of a shuttle launch.
2. Look at the launch to orbit sequence drawing. Name each part of the space shuttle. Discuss with students the sequence and talk about each part as it separates from the orbiter. Use the drawing of the shuttle parts to demonstrate how each part separates.
3. Review the launch to orbit sequence using the drawings of the space shuttle and its parts. Remind the students that the orbiter is the only part of the shuttle that travels into space. Use ordinal numbers, like *first*, *second*, and *third*, to describe the sequence of events.
4. Introduce the enlarged versions of the shuttle sequence cards. Use the cards to describe the events in the launch to orbit sequence. Use them to put the events in the correct order.
5. Let students practice the sequence of events during a shuttle launch using the cards. Have students refer to the numerals on the back of the cards to self-check.



6. Remember to tell students that one of the missions of the space shuttle, after launch, is to carry hardware and people to and from the ISS.

Second Class Period:

1. Review the sequence of a space shuttle launch using models, videotapes, diagrams, and drawings.
 2. Let students practice the correct sequence of a space shuttle launch using the enlarged space shuttle launch to orbit sequence cards. Encourage them to self-check using the numerals on the back of the cards.
 3. Have students review the sequence of events using an individual set of shuttle sequence cards. Give students a set of cards to color and cut apart.
 4. Ask students to place the cards in the correct sequence. Monitor the activity to make sure students place cards in order and sequence from left to right.
 5. Ask students to orally describe the steps in a shuttle launch using the shuttle launch to orbit cards. Encourage students to use ordinal numbers, such as *first*, *second*, and *third* when describing each step. Have students store the cards in a plastic bag.
- Use a map or globe to show students where they live. Locate the Kennedy Space Center in Florida. Find the Atlantic Ocean. Use labels or stickers to mark these locations. Remind students that the solid rocket boosters fall into the Atlantic Ocean. Have the class generate ideas about why the space shuttle launch pad is located close to the ocean. Ideas should include safety issues.
 - Use a globe to demonstrate the orbiter circling or orbiting the Earth. Ask students to remember that the orbiter is the only part of the space shuttle that orbits the Earth. Mention that the ISS also orbits the Earth. In space, the orbiter will dock, or join, with the space station and deliver supplies, people, and hardware. Review the concept, introduced in *Activity 2*, page 15, of objects in the sky made by humans.
 - The space shuttle has both solid and liquid propellants or fuel. The solid rocket boosters have solid propellant, and the external tank has liquid propellant. Discuss the differences between a solid and a liquid. Encourage students to generate a list of the characteristics of a solid and a separate list of the characteristics of a liquid. Compare and contrast the lists. Make a list of things that are solid and things that are liquid. In their journals or on a sheet of paper, have students draw pictures of objects that are solids or liquids. Have students or the educator label the drawings. Students may also collect pictures of solids and liquids. Use the pictures to practice sorting or classifying.
 - From the *Suggested Reading* list or other sources, select books that feature descriptions and pictures of shuttle launch to orbit sequences. Examples include *The Space Shuttle* by Jacqueline Langille and Bobbie Kalman, *Space Shuttle* by Mark Bergin, and Jan Graham's *Best Book of Spaceships*. Read to the class or let students read individually. Ask students to describe the sequence of events in a shuttle launch using pictures in the books.

Assessment

- Observe students as they place the shuttle sequence cards in order. Ask students to describe each step in the launch to orbit sequence.

Enrichment

- Have students draw the sequence of events in a journal or on a sheet of paper. If appropriate, have students label the parts of the shuttle.



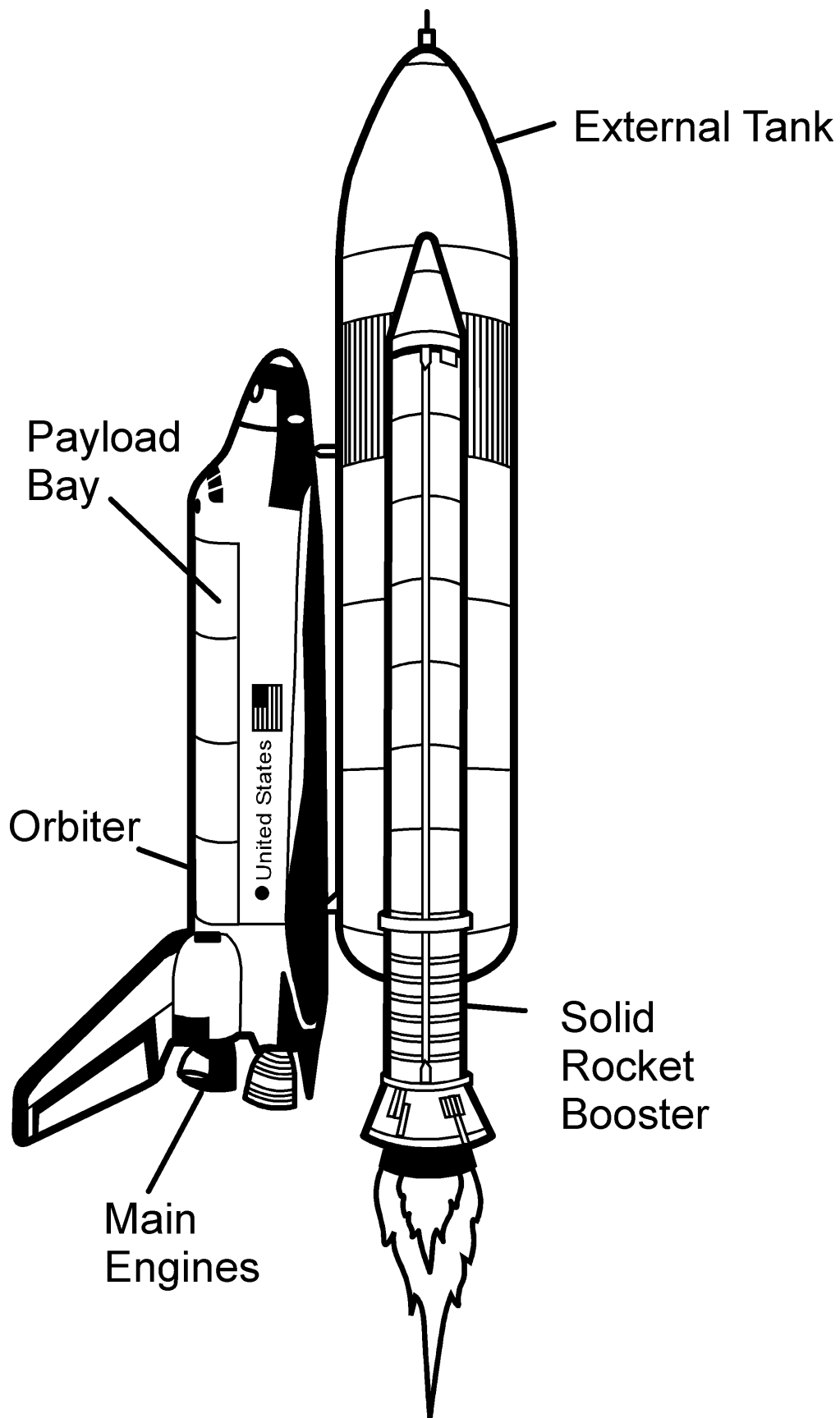


Figure 2. Side View of Space Shuttle



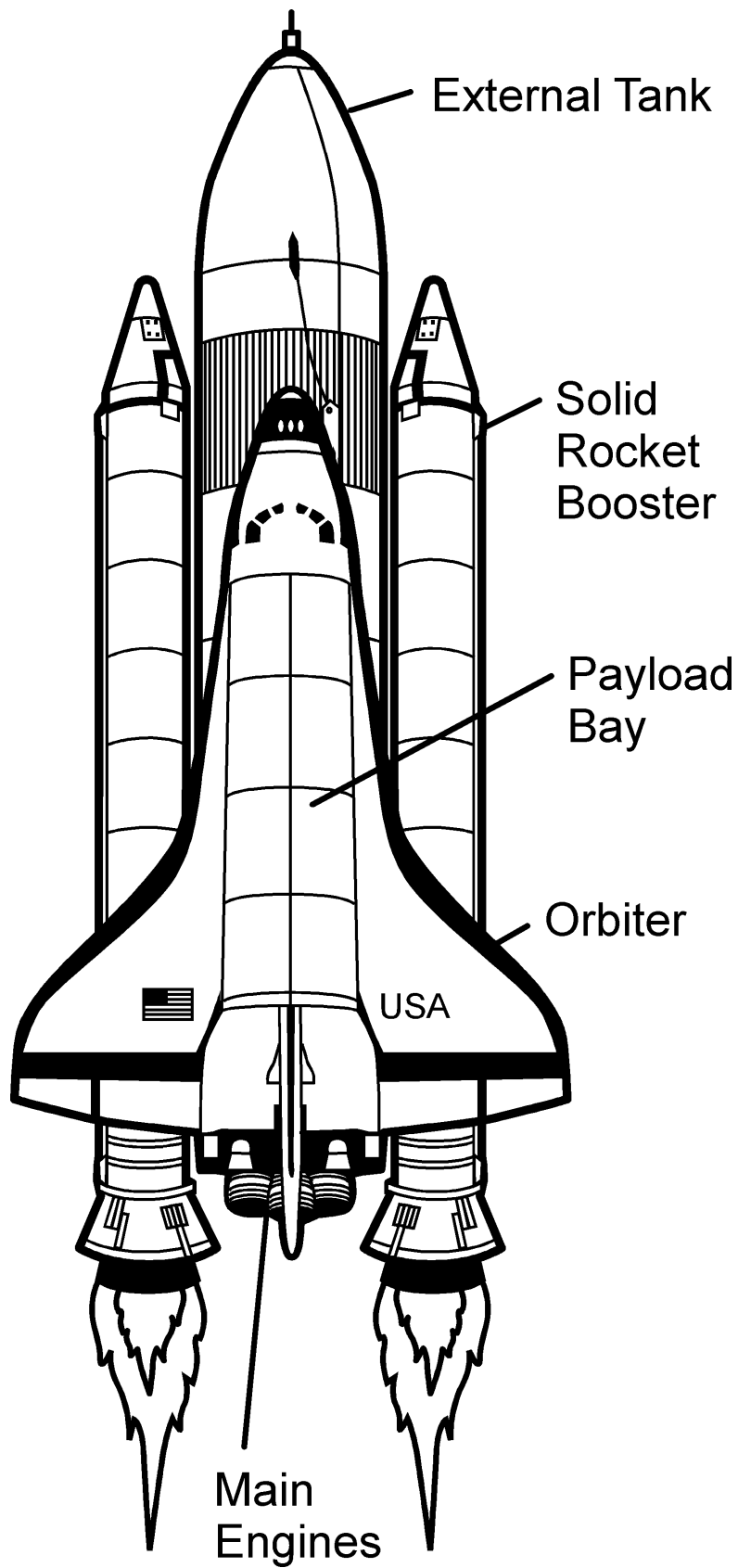


Figure 3. Parts of the Space Shuttle

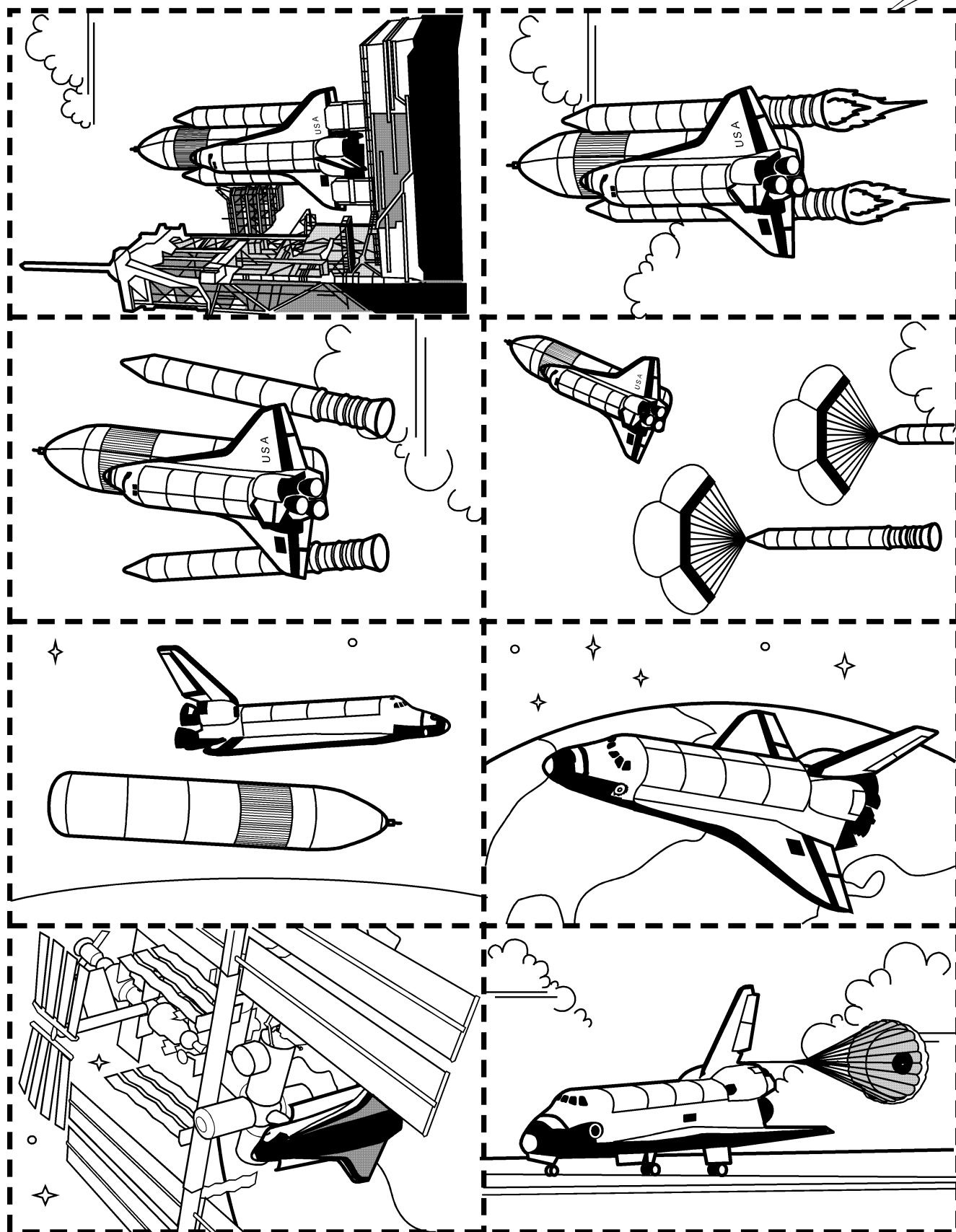


Figure 10. Shuttle Sequence Cards



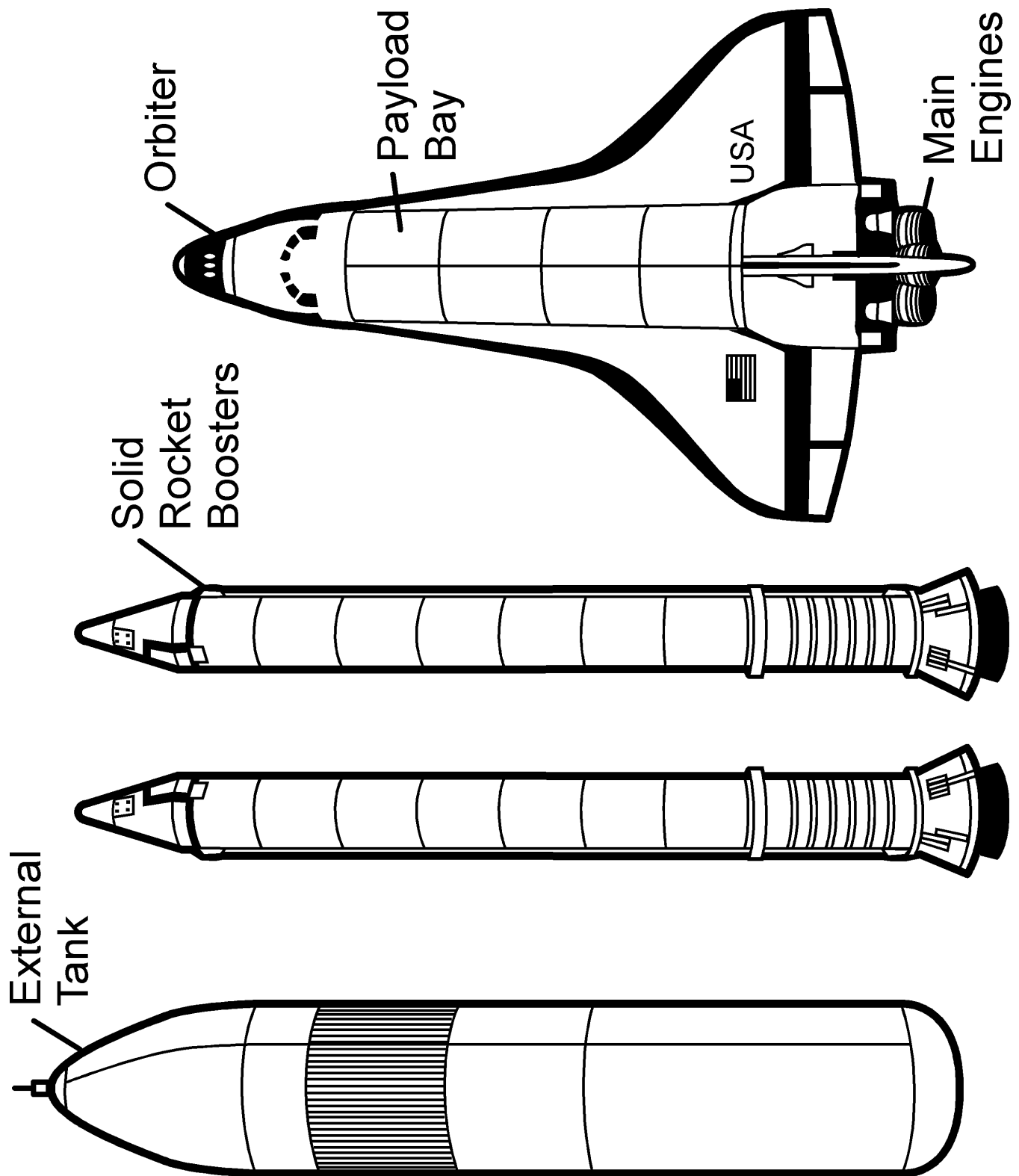


Figure 11. Space Shuttle Parts



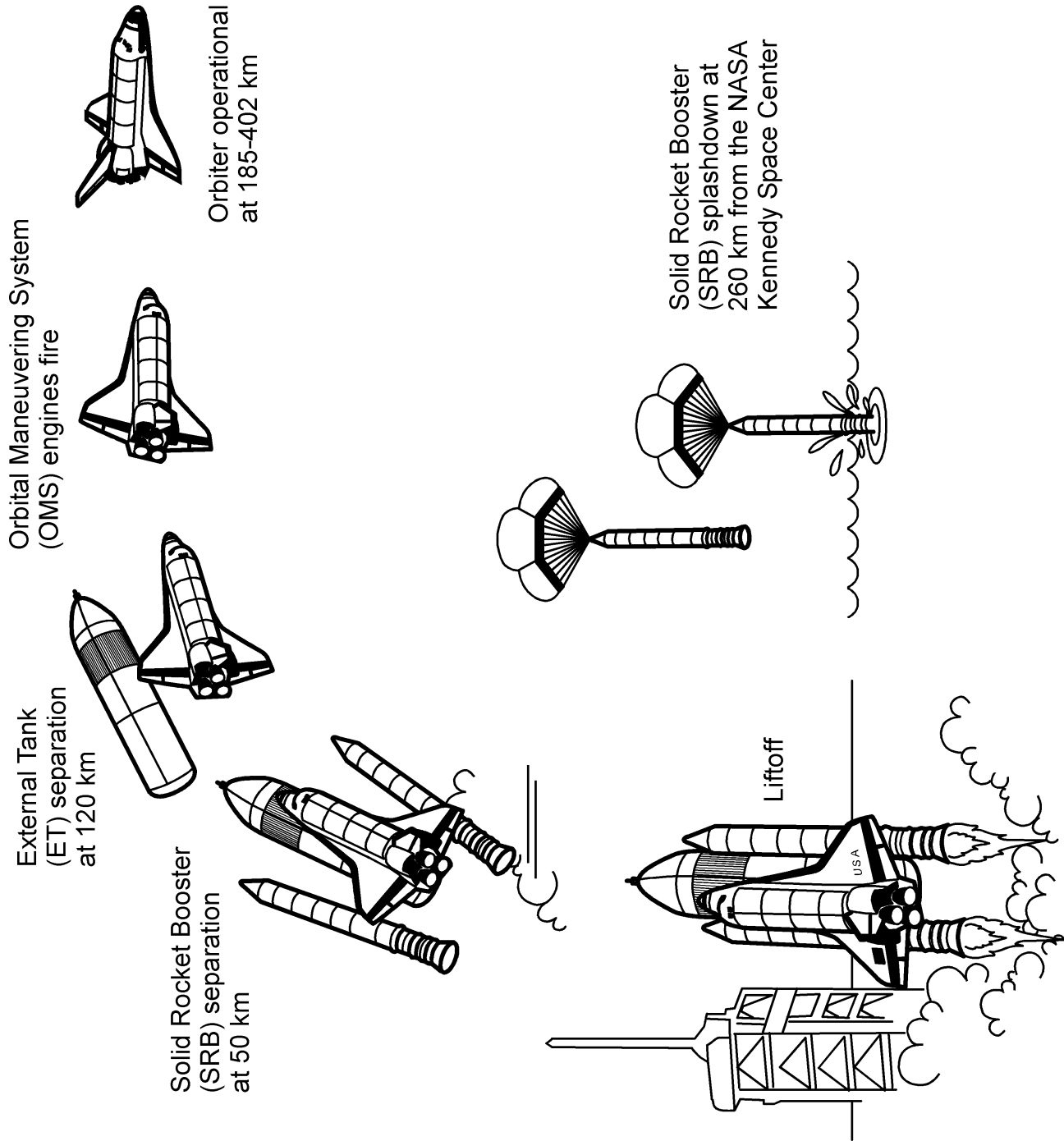


Figure 12. Shuttle Launch to Orbit Sequence